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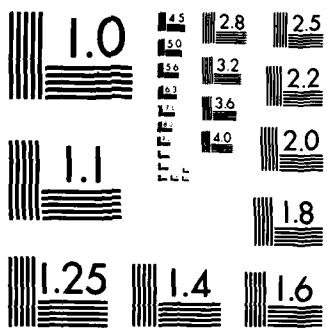

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THE EFFECTIVENESS OF THE IMPROVED $NaHPO_4$-SnF_2-$ZrSiO_4$-SiO_2 PROPHYLACTIC PASTE

Final Report

Virgil E. Whitehurst, Ph.D.

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The Effectiveness of the Improved $NaHPO_4$-SnF_2-$ZrSiO_4$-SiO_2 Prophylactic Paste

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Introduction

Stannous fluoride is an agent which has been used in solutions, dentifices and prophylactic pastes to reduce the incidence of dental caries and there is little doubt that SnF2 is effective in reducing dental caries. However, there is evidence to suggest that aging decreases SnF2 compound's ability to reduce enamel solubility. The reduction in effectiveness of SnF2 compounds is explained in part by the oxidation of stannous ion to the stannic ion. It has also been suggested that this stannic ion precipitation may have some effect on the fluoride ion. It is for this reason and others that dentists and dental scientists recommend that freshly made SnF2 solutions be used for maximum effectiveness. This is also the reason that a reservoir of SnF2 ions is incorporated into crest toothpastes and SnF2 prophy pastes.

Rationale for this Study

In the early 60's, Muhler[3] advanced the idea that if a tooth was highly polished, it would be more likely to resist plaque formation. From this idea a zirconium silicate - stannous fluoride prohylactic paste was developed. This prophy paste (a good polishing agent) was to be used as a preventive measure in reducing dental caries and periodontal

disease. This $ZrSiO_4$-SnF_2 prophy paste was used in the Army Self Applied Fluoride Expedient Program. However, a great deal of time elapsed between the manufacturing of the prophy paste and its use. Therefore, there was a need to determine the effect of aging on this prophy paste.

Purpose of this Study

(1) To investigate by in-vivo enamel solubility techniques the effect of aging on Zirconium Silicate-Stannous Fluoride Prophy Paste,

Methods and Procedures

Four (4) different lots of factory prepared zirconium silicate-stannous fluoride prophy paste were used in this study. The enamel solubility tests were carried out on day 0 (day prophy paste was made), 1 and 2 weeks, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 months.

Young female rats were used throughout this study. A total of 180 rats (80-90 grams) were randomly divided into six (6) equal groups, i.e. four (4) experimental, one (1) control, and one (1) positive control. All rats received a 30 second topical treatment on each hemi-jaw. Distilled water was applied to the hemi-jaws of the control animals and crest toothpaste (fresh) was brushed on the hemi-jaws of the experimental control. The mouths of the rats were held open by a specially prepared wire rack which partially immobilized the rats. The rack did not harm the animals. One hour after the topical application the rats were sacrificed by chloroform inhalation, their hemi-jaws removed and carefully cleaned of gingival tissue and bone using a sharp scapel. The teeth were then embedded in acrylic to the gingival margin with the aid of a

embedding bar. A micro-layer of acrylic solution was used to cover the gingival margin and any exposed bone.

The determination of acid solubility of the topically treated enamel was conducted by using a colormetric method first described by Fiske and Sublarow.[4] This method was modified for use in in-vivo animal studies by Buttner and Muhler[5].

A total of 10 milliliters of 0.2 normal sodium acetate buffer (ph 4.0) was utilized in this procedure. The buffer was placed in a beaker along with a single hemi-jaw and stirred with a electric stirring apparatus at 60 revolutions per minute for 20 minutes. The stirring rod was kept approximately one-half-inch above the hemi-jaw. At the end of the designated time, the hemi-jaw was removed from the buffer solution and analyzed for inorganic phosphorous.

The method for phosphorous analysis is based on the principle that inorganic phosphorous reacts with molybdate reagent and a blue color is formed when the resulting phosphomolybdic acid is reduced by p-aminonaphthol sulfonic acid.

A total of 10 millimeters of the decalcifying buffer containing the inorganic phosphorous, in addition to 2.5 ml of molybdate reagent, 1.0 ml of p-aminonaphthol sulfonic acid were added and diluted with distilled water to 25.0 mls in a volumetric flask. The reactants were allowed to stand, at least 10 minutes, and the solution was then read on a

Klett-Summerson photoelectric colormeter, using a red filter, (66 mm), against a distilled water blank.

The per cent reduction in acid solubility was calculated as follows:

$$\frac{C-E}{C} \times 100 = \text{per cent effectiveness}$$

C = mean micrograms of phosphorous in the control group

E = mean micrograms of phosphorous in the experimental group

Example:

$\overline{X}$ micrograms phosphorous, control = 65.0

$\overline{X}$ micrograms phosphorous, experimental = 25.0

Calculations: percent reduction = $\frac{65-25}{65}$ = 61.5%
in acid solubility

Results and Discussion:

The mean protection per cent afforded by zirconium silicate-stannous fluoride prophy paste for enamel against dissolution is shown in Table I. Also shown are the standard errors of the mean and statistical analyses of these data.

These data show that freshly manufactured $ZrSiO_4$-SnF_2 prophy paste is very effective in inhibiting enamel solubility (79.8%) in the rat. These data further show that there are no significant changes in this prophy paste's ability to protect enamel against acid solubility for a period of 30 days. The first significant change in the protection of enamel afforded by this prophylactic paste is observed after 1 month ($p=.05$). However, it should be noted that the $ZrSiO_4$-SnF_2 paste is still quite effective and there are no further significant reductions in protection until the 5th month. Further significant changes in the

performance of this prophylactic paste are noted at 8 and 12 months.

Data in Table I clearly shows that at the end of 12 months, the effectiveness of this prophy paste against enamel solubility in the rat has been reduced by 52.1%. However, this prophy paste still is effective against enamel solubility (38.2%).

Results obtained in this study show that aging does have a deleterious effect on this SnF2 prophy paste. Aging seems to have very little effect during the first 30 days after manufacture of the paste. These data agree with work reported by Hefferren[6] who found that soluble stannous ions gradually decrease with age and that approximately 50% of the stannous ions may be lost during the first month. He further states that soluble fluoride ions decrease at a much less rapid rate over the same period. However,as the stannous ions are oxidized to stannic complexes, they may affect the soluble fluoride ions. The reduction in the soluble stannous ion concentration is thought to be pH dependent. This concentration is stable at pH levels of 3-4. As the pH increases to a range of 5-6, the stannous ion concentration is decreased and the effectiveness of the prophy paste against enamel dissolution is reduced.

As the prophy paste ages, the concentration of stannous and fluoride ions are reduced and thus the ability to protect enamel is decreased.

There are several studies[7,8,9] whose purpose was to investigate the effect of aging on SnF2 solutions. The results of these studies showed that the ability of SnF2 preparations to inhibit enamel solubility is reduced by aging. However, this conclusion is by no means universally

accepted. Shannon[10] reported no significant lost of protective effectiveness with SnF2 solutions aged for 90 days. These were specially prepared SnF2 solutions in order to protect the active agents against loss in effectiveness. Glycerin was incorporated into the solutions to slow the oxidization of the stannous ions. March[11] found that the ability of SnF2 solutions to protect against acid decalcification was enhanced by age.

Summary

The marked effectiveness of freshly manufactured ZrSiO4-SnF2 prophy paste decreases significantly after a period of 30 days. As the prophy paste continues to age, it is decidedly less effective than freshly prepared prophy paste in reducing enamel solubility.

TABLE I

EFFECT OF AGE ON PROTECTIVE PERFORMANCE
OF PREVENTIVE DENTISTRY PROPHYLACTIC PASTE

Age of Prophylactic Paste	Protection Per Cent Mean	S.E.	Statistical Analyses T	P
Fresh	79.8	1.56	-	-
1 week	77.6	1.83	1.78	N.S.
2 weeks	76.0	1.20	1.93	N.S.
1 month	69.7	2.36	3.57	.05
2 months	67.1	2.45	3.69	.05
3 months	66.8	2.05	4.25	.05
4 months	61.7	2.90	6.25	.05
5 months	60.2	1.68	8.56	.001
6 months	62.0	1.79	5.59	.05
7 months	55.9	1.84	9.73	.001
8 months	51.2	2.23	10.51	.001
9 months	47.3	1.02	13.31	.001
10 months	42.8	1.72	16.81	.001
11 months	40.0	2.23	18.33	.001
12 months	38.2	1.12	21.67	.001

References

1. Muhler, J. C., Present Status of Topical Fluoride Therapy. J. Dent Child. 26: 173, 1959.

2. Hefferren, J. C., Qualitative and Quantitative Tests for Stannous Fluoride - J. Pharm. Sciences, 52: 1090, 1963.

3. Muhler, J. C., Dudding, N. J. and Stookey, G. K.: The Clinical Effectiveness of a Particular Particle Size Distribution of Zirconium Silicate for use as a Cleaning and Polishing Agent for Hard Tissues. J. Perio. 35: 481, 1965.

4. Fiske, C. H. and Subbarow, Y: The Colormetric Determination of Phosphorus. J. Biol. Chem. 66: 375, 1925.

5. Buttner, W. and Muhler, J. C.: A Method for the Determination of Enamel Solubility in Intact Rat Molars using Highly Concentrated Fluoride Solutions J. Dent. Res. 36: 897, 1957.

6. Hefferren, J. J., Zimmerman, M. and Koehler, H. M.: Reactions of Stannous Fluoride with Some Inorganic Compounds. J. Dent res. 45:1395, 1966.

7. Muhler, J. C. and Day, H. G.: Relation of pH to the Effectiveness of Sodium Fluoride and Stannous Fluoride in Decreasing Enamel Solubility, J. Dent. Res. 31:102, 1952.

8. Muhler, J. C., Day, H. G. and Nebergall, W. H.: Relationship Between pH, Age, and Concentrations of Solutions of Stannous Fluoride and Sodium Fluoride in Decreasing Enamel Solubility and Affecting the Uptake of Fluorine, J. Dent. Res. 31:756, 1952.

9. Hatton, W. E., Nebergall, W. H. and Muhler, J. C.: The Removal of Fluorine from Dilute Solutions of Sodium Fluoride and Stannous Fluoride by Powdered Dental Enamel, J. Dent. Res. 34:350, 1955.

10. Shannon, I. L.: Effect of Storage on the Laboratory Performance of Aqeous Solutions of Stannous Fluoride. J.S.C. D.A., 32:67, 1964.

11. March, T. Torell, P. and Hals, E.: Effect of Topically Applied Agents on Enamel. ADA Odont. Scand. 14:335,1956.

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